

## Progression to Net-Zero Emission Propulsion Technologies for the Rail Sector

DATE: 1/4/2024

SUBJECT: Request for Information (RFI)

**Modifications**

All modifications to the RFI are [HIGHLIGHTED] in the body of the RFI.

Mod. No.	Date	Description of Modification
000001	1/4/2024	Response due date extension  Responses to this RFI must be submitted electronically to <b>GreenRail@ee.doe.gov</b> no later than 5:00p.m. (ET) on <b>February 12<sup>th</sup>, 2024.</b>

**Description**

The U.S. National Blueprint for Transportation Decarbonization set the goal to achieve net-zero carbon emissions in the transportation sector – including rail – by 2050.<sup>1</sup> This transformation to net-zero emission technologies requires coordination among all aspects of the rail supply chain, including feedstock supply, alternative fuel production, locomotive engine manufacturers, safety implementation, customer demand, and government regulation. To develop a national strategy to decarbonize the rail sector, two critical questions must be addressed:

- 1- Which alternative rail propulsion technologies are most promising technically and economically?
- 2- What is the timeline for the rail sector to transition to net-zero emission technologies?

The purpose of this RFI is to understand what is driving the rail sector towards adopting alternative propulsion technologies, which technologies seem most promising, and what are the key barriers to achieving the transition to net-zero emissions by 2050. The propulsion technologies under consideration for this RFI for **transitional, interim use until 2030 are:** biodiesel, renewable diesel, ammonia, methanol, hydrogen fueled internal combustion engines, and ethanol. The net-zero emission technologies under consideration for this RFI for **mid- to long-term use are:** hydrogen fuel cells, batteries (tenders or built-in), and direct electrification (catenary), or a combination of different technologies. Each alternative propulsion technology comes with its own set of regionally sensitive advantages and disadvantages. This RFI is an attempt to aggregate knowledge from stakeholders to help guide actions regarding future

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<sup>1</sup> <https://www.energy.gov/eere/us-national-blueprint-transportation-decarbonization-joint-strategy-transform-transportation>

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propulsion technologies, research and infrastructure investments, and coordination among key stakeholders to ensure that the rail sector is meeting or exceeding U.S. decarbonization milestones.

## Background

The United States Government, including the U.S. Department of Energy (DOE), has established ambitious goals to address global climate change and is committed to work with industry to formulate and implement robust and actionable decarbonization plans. DOE is tasked with understanding the alternative propulsion technologies landscape and overcoming barriers to innovation and adoption of alternative propulsion technologies. The Biden-Harris Administration has committed the United States to address the climate crisis, including both ambitious domestic action and sustained international leadership. Recognizing that 2% of domestic transportation greenhouse gas (GHG) emissions come from the rail sector, the U.S. must do more to bend the emissions trajectory from the rail sector. The historic memorandum of understanding (MOU)<sup>2</sup> for Transportation Decarbonization among DOE, the Department of Transportation (DOT), the Environmental Protection Agency (EPA), and the Department of Housing and Urban Development (HUD) intends to bring together public and private partners to accelerate action in rail decarbonization.

To set domestic rail on an ambitious net-zero emission trajectory, commercially viable, well-to-wheel net-zero emission line-haul locomotives are needed in the domestic fleet by 2030. Thus, an ambitious alliance is needed between the private sector, research institutes and regulatory entities to develop, demonstrate, and deploy net-zero emission locomotives and infrastructure together by 2030 to make net-zero emission propulsion the natural choice for railroads. One of the first actions outlined in the National Blueprint for Transportation Decarbonization is to identify and set ambitious decarbonization milestones for the rail sector.

## Purpose

The purpose of this RFI is to aggregate knowledge from rail stakeholders to help guide actions regarding future propulsion technologies, infrastructure requirements, and coordination among key stakeholders to ensure that the rail sector is meeting or exceeding U.S. decarbonization milestones. DOE's Office of Energy Efficiency and Renewable Energy (EERE) is specifically interested in information on the rail sector stakeholder's current alternative fuels trajectory, the driving forces behind it, and the key barriers to achieving this transition.

## Disclaimer and Important Notes

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<sup>2</sup> [https://www.energy.gov/sites/default/files/2022-09/mou-doe-dot-epa-hud-final\\_09-15-2022.pdf](https://www.energy.gov/sites/default/files/2022-09/mou-doe-dot-epa-hud-final_09-15-2022.pdf)

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This RFI is not a Funding Opportunity Announcement (FOA), therefore, EERE is not accepting applications at this time. EERE may issue a FOA in the future based on or related to the content and responses to this RFI, however, EERE may also elect not to issue a FOA. There is no guarantee that a FOA will be issued as a result of this RFI. Responding to this RFI does not provide any advantage or disadvantage to potential applicants if EERE chooses to issue a FOA regarding the subject matter. Final details, including the anticipated award size, quantity, and timing of EERE funded awards, will be subject to Congressional appropriations and direction.

Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development. This RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. EERE will review and consider all responses in its formulation of program strategies for the identified materials of interest that are the subject of this request. EERE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that EERE is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind EERE to any further actions related to this topic.

## **Confidential Business Information**

Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email two well-marked copies: one copy of the document marked “confidential” including all the information believed to be confidential, and one copy of the document marked “non-confidential” with the information believed to be confidential deleted. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

## **Evaluation and Administration by Federal and Non-Federal Personnel**

Federal employees are subject to the non-disclosure requirements of a criminal statute, the Trade Secrets Act, 18 USC 1905. The Government may seek the advice of qualified non-Federal personnel. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The respondents, by submitting their response, consent to EERE providing their response to non-Federal parties. Non-Federal parties given access to responses must be subject to an appropriate obligation of confidentiality prior to being given the access. Submissions may be reviewed by support contractors and private consultants.

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## Request for Information Questions

### General Questions:

1. What is your view of zero-emission, or net-zero emission, rail propulsion technologies in the next 5 years? 10 years? 30 years? In your response, please include which rail propulsion technologies for line-haul and railyard operations do you see developing most promisingly. Please provide as many details as possible e.g., battery chemistry for batteries, charger type for electrification, fuel cell vs combustion, feedstock source, etc.
2. What efforts are you aware of to decarbonize rail transportation, including ways to reduce diesel fuel use? Are you aware of intermediate decarbonization milestones for rail transportation? Are you aware of longer term decarbonization goals for rail transportation? If so, describe how those goals might be met, including whether low-carbon biofuels will play a role.
3. What are the benefits and challenges of the various rail propulsion technologies as compared to the other alternatives? If possible, please provide a ranking of the alternative technologies starting with the most viable/promising option.
4. What obstacles to rail decarbonization is the industry facing? What plans can be put in place to overcome these challenges?
5. For direct electrification of rail, how do you foresee the infrastructure (such as overhead catenary) being built? Who should own and operate the infrastructure?
6. What collaboration with any other entities do you think will be necessary to support the decarbonization of rail transportation?
7. What are the most critical gaps (e.g., with respect to standards, regulations, supply chain, labor) that need to be filled to support acceptance of and markets for alternative rail propulsion technologies?
8. What infrastructure is required to support promising alternative rail propulsion technology? Are there specific routes, railyards, or network segments that would be a good candidate for alternative propulsion technologies (e.g., catenary, hydrogen fuel cells, or batteries)?
9. What type of service testing, or derisking, of these propulsion technologies do you think are necessary for each alternative rail propulsion technology?
10. What government actions do you think are necessary to help move the rail sector towards net-zero emissions?
11. Other than tax credits, what opportunities are there to incentivize transition to clean fuels, recognizing that costs are likely to be higher in the near to mid-term? (For example, vehicle consumer incentives in the on-road sector include the use of high-occupancy vehicle (HOV) lanes, free workplace charging, etc.).
12. What type of workforce challenges are present? Are you aware of any workforce development programs that are relevant to the clean energy transition in the rail sector?

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13. Are you aware of any goals for Total Cost of Ownership (TCO) willingness to pay for advanced technologies? Recognizing that DOE and industry are driving to cost parity with diesel in the long term, what do you think the goals should be regarding reasonable extra costs over the diesel baseline in the near term?
14. In your opinion, how do certain technologies (e.g. battery) compare for different use cases (e.g. line haul, switching)?
15. In your opinion, what percentage of overall locomotives could reasonably be expected to be zero-emission locomotives between now and 2050? How do you think production might scale up over time?
16. How do you think power needs should be estimated for the rail industry over time? E.g. number of locomotives or switchers?
17. What do you think should be the estimated global market size for net-zero emission locomotives or retrofitting technologies?

### Request for Information Response Guidelines

Responses to this RFI must be submitted electronically to **GreenRail@ee.doe.gov** no later than 5:00p.m. (ET) on **February 12<sup>th</sup>, 2024**. Responses must be provided as attachments to an email. It is recommended that attachments with file sizes exceeding 25MB be compressed (i.e., zipped) to ensure message delivery. Responses must be provided as a Microsoft Word (.docx) attachment to the email, and no more than 15 pages in length, 12-point font, 1-inch margins. Only electronic responses will be accepted. Please identify your answers by responding to a specific question or topic if applicable. Respondents may answer as many or as few questions as they wish.

EERE will not respond to individual submissions or publish publicly a compendium of responses. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed. Respondents are requested to provide the following information at the start of their response to this RFI:

- Company / institution name;
- Company / institution contact;
- Contact's address, phone number, and e-mail address.

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